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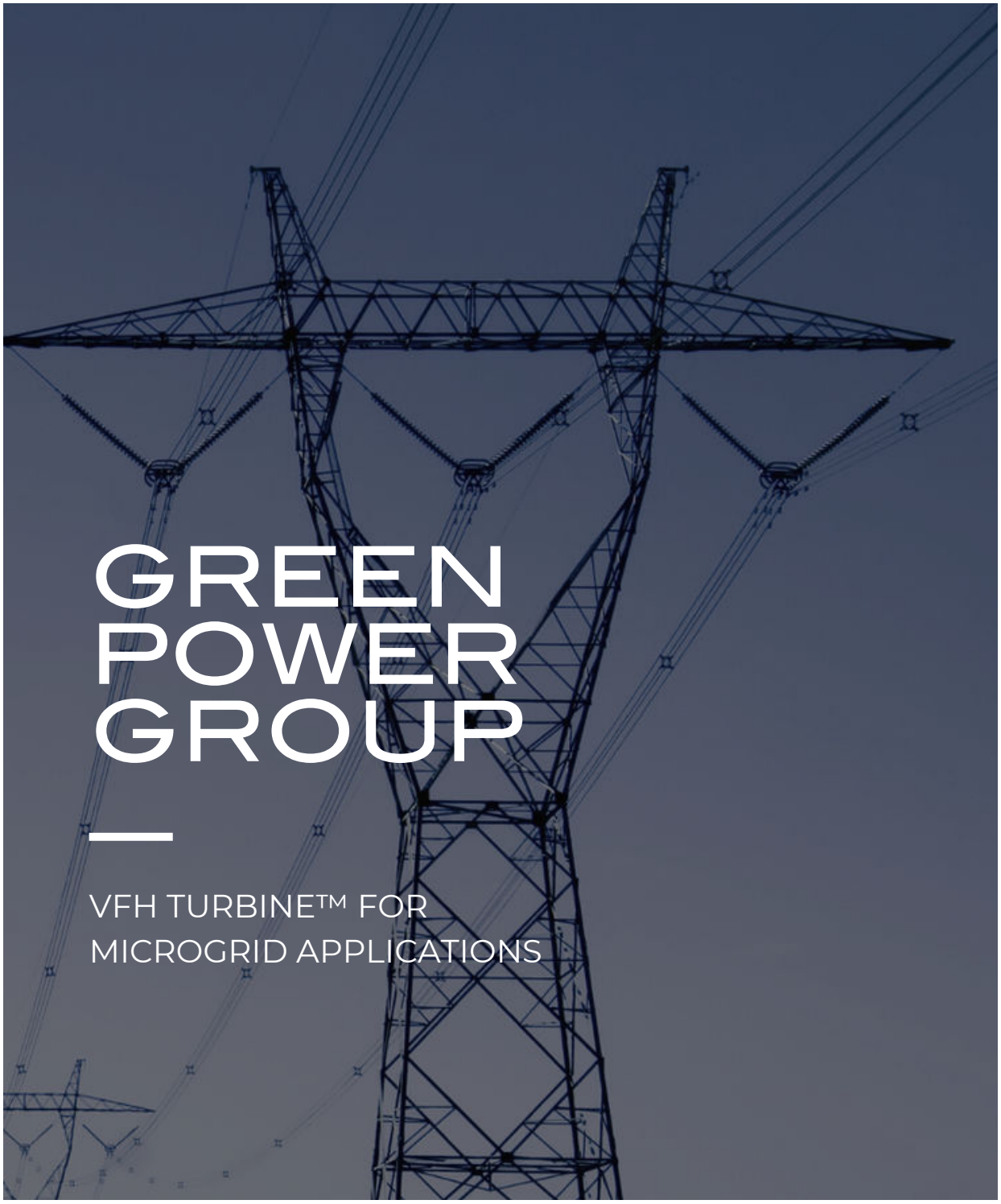

GREEN POWER GROUP

VFH TURBINE™ FOR MICROGRID APPLICATIONS

www.vfhturbine.com

WHAT IS A MICROGRID?

A microgrid is a local energy grid with control capability, which means it can disconnect from the traditional grid and operate autonomously. According to the U.S. Department of Energy Microgrid Exchange Group, the following criteria define a microgrid: A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity for the grid. A microgrid can connect and disconnect from the grid to operate in grid-connected or island mode.

Every day, more individuals are becoming concerned with resiliency and reliance of power. What can we do when there is an outage, and the grid goes dark? The solution to this problem is microgrids, in partnership with renewable energy, such as small hydro technology like the VFH Turbine™ from Green Power Group PR, LLC.

A microgrid must have a reliable generation source to meet the electricity demands of its users. Since microgrids are an older concept, the electricity supplied to microgrids has historically been from gas-powered generators. However, despite the low cost of using non-dammed hydropower, not to mention the environmental benefits of switching from fossil fuel generation to hydropower, many of the microgrids being designed today supply electricity with a combination of solar plus battery storage. The reliable VFH System is affordable and can be rapidly deployed.

MODELING AND CONTROL OF VFH TURBINE

Distributed generation systems such as small-scale hydropower from VFH Turbine™, ranging from 100 kW to 5 MW, are gaining increasing interest. Small Hydropower Plants (SHP) for a DC microgrid are based on passivity theory. Our SHP comprises a proprietary VFH Turbine™, a permanent magnet synchronous generator (PMSG), a voltage source converter, and a DC microgrid. The electrical, mechanical, and hydraulic dynamics in the mathematical model of the SHP are considered. We employ a nonlinear controller based on passivity, whose stability is guaranteed under reasonable conditions. Our simulation results show better performance of the proposed controller when compared with a PI controller in all of the scenarios that were considered.

Microgrids are local electric grids integrating distributed generation and consumption, energy storage and management, and power control. They can be an alternative for the energy supply of multiple houses, buildings, businesses, utility companies, small communities, or a broader region. Nearly all VFH systems are remotely controlled and monitored 24/7/365 from locations worldwide.

Thus, VFH hydro systems are relevant for energy generation in off-grid systems in remote areas and for new contexts where the utility grid is available. VFH Turbine™ presents the design of a smart microgrid with small-scale hydro generation. It is a practical application with the integration of VFH Turbine™: a low-head propeller turbine or higher-head Pelton design. The microgrid can be designed and implemented in a small remote off-grid location. The microgrid can operate in grid-connected and islanded modes and feed the local loads. The connection of the VFH Turbine™ into the microgrid is not based on the integration of wind generators and PV inverters.

ADVANTAGES OF MICROGRIDS

- *Enhances resilience/recovery*
- *Improves electric reliability*
- *Improve the operation and stability of the regional electric grid*
- *Improves the environment and promotes clean energy*
- *Strengthens the central grid*
- *Diversified risk rather than concentrated risk*
- *Improves community well-being*
- *Enable highly-efficient renewable sources, reducing fuel use, line losses, and carbon footprint*
- *Reduce grid congestion and peak loads*
- *Support places of refuge in regional crises and first responders*

HOW MICROGRIDS ARE BEING UTILIZED

The grid connects homes, businesses, and other establishments to central power sources, which allow us to use appliances, heating/cooling systems, and electronics. But this interconnectedness means everyone is affected when part of the grid needs to be restored, and this is where a microgrid can help.

A microgrid generally operates while connected to the grid. Still, importantly, it can break off and operate on its own using local energy generation in times of crisis, like storms, power outages, or other reasons. A microgrid can be powered by distributed generators, batteries, and renewable resources like solar panels. A microgrid might run indefinitely depending on how it's fueled and how its requirements are managed.

A microgrid provides backup for the grid in case of emergencies and can also be used to cut costs or connect to a local resource that is too small or unreliable for traditional grid use. A microgrid allows communities to be more energy independent and, in some cases, more environmentally friendly.

Microgrids can become electrically isolated from the grid during an outage. When the grid goes down due to a severe weather event to a knocked-over telephone pole, you need to be disconnected from the grid or "islanded" to continue producing and using electricity. As such, one key feature of a microgrid is its ability to continue operating even when the larger grid goes out.

Microgrids would be beneficial in many cases, such as the recent hurricanes in Puerto Rico. Many power outages before storm damage are planned outages or rolling blackouts. For countless people, a microgrid would be a solution to their power problem by being able to produce their own power for everyday use or in emergencies. These households could disconnect from the main grid and be self-sufficient until the main grid is back online.

CONTACTS

Our team of experts and industry partners have distinguished careers as leaders in environmental applications worldwide.

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